

LONG TERM DURABILITY OF MATERIALS AND STRUCTURES: MODELING AND ACCELERATED TECHNIQUES

INITIATIVE ANNOUNCEMENT FOR FY 1998

DIRECTORATE FOR ENGINEERING (ENG)

DEADLINE DATE: *MARCH 25, 1998*



NATIONAL SCIENCE FOUNDATION

INTRODUCTION

The Engineering Directorate of the National Science Foundation (NSF) announces a collaborative research initiative on the long-term durability of materials, machines and structures. The focus is on innovative accelerated tests and modeling of deterioration behavior, which will enable reliable prediction of long-term performance from short-term tests. A goal of the initiative is to provide close links between basic research and engineering applications in the field of deterioration science by coordinating research efforts and combining resources from a number of agencies including the Federal Highway Administration (FHWA) and several State Departments of Transportation (DOTs) as well as other Federal agencies on a case by case basis in terms of co-funding and utilization of testing facilities. Researchers are encouraged to visit the NSF Engineering web-site (www.eng.nsf.gov/programs/nsf98-42.htm) for any update on this initiative.

PROGRAM DESCRIPTION

This initiative is aimed at developing innovative short-term laboratory or in-situ tests, which allow accurate, reliable prediction of long-term performance of materials, machines and structures. To accomplish this goal it is necessary to better understand the fundamental nature of the deterioration and damage processes in materials and to develop innovative ways to model the behavior of these processes as they affect the life and long-term performance of components, machines and structures. Size effects in scaling up from laboratory specimens to actual structures need to be addressed. Accelerated testing and durability modeling techniques developed will need to be validated by comparing their results with performance under actual operating conditions. The results of the initiative will lead to improved durability, life cycle performance, safety, reduced maintenance and lower cost which in turn should lead to superior machines and structures.

The initiative aims to support fundamental research by individual investigators and small groups on new concepts and methods for accurately assessing the durability of materials, machines and structures, with an emphasis on high-risk/high-payoff research. The nation's annual expenditures to replace deteriorated equipment, machines, and components of the infrastructure are enormous. Most machines, structures and facilities deteriorate over a period of years or decades and eventually wear out, break down, or become unproductive or unsafe. Understanding when to replace them or how to prolong their useful lifetime is becoming increasingly important. In some cases, a whole unit or system must be replaced when a single critical component fails. Once it becomes possible to accurately predict, measure, and control the rate of deterioration it is possible to closely determine the life-cycle of these critical components. That, in turn, makes it feasible to develop design methodology and/or inspection, monitoring, and replacement strategies, which allow significant extension of the life of the complete system, thus resulting in significant savings to society. Progress has already been made in several areas. For example, in the case

of metallic creep, we have time-temperature correlation parameters that permit results of short duration tests at elevated temperatures to be used reliably to predict long term behavior at lower temperatures.

Much of the deterioration of concern here is due to environmental effects and/or exposure to loads, speeds and other operating conditions that are not fully anticipated in the original design. There are many forms of deterioration to consider, such as fatigue, overload, ultraviolet damage, corrosion, and wear. Materials of interest include the full spectrum of construction materials, metals, ceramics, polymers, composites, and coatings. Application areas include, but are not limited to, units of the constructed infrastructure such as machines, structures (above and below ground), transportation systems and units, and manufacturing machinery. Some possible research topics could be

- multiple interactive effects and deterioration mechanisms
- accelerated techniques, related instrumentation and model validation to long-term field data
- determination of service life from wear tests and modeling
- deterioration of structural materials and protective coatings (e.g. polymeric coatings on bridges) as a function of environment
- failure mechanisms of composite materials (e.g. reinforced-concrete failure and corrosion protection systems)
- size effects in testing, instrumentation and modeling
- relevant statistical methods and reliability

Proposed topics could include careful evaluation of available well-documented data on long-term performance in light of short-term tests and relevant models, and development of completely new testing, instrumentation and modeling techniques. All proposals should address the ways in which education and training are integrated within the research program. Researchers are encouraged to explore new approaches and form new teams, where appropriate, including for example the participation of mathematical and statistical scientists.

Funding for this initiative is derived from a coordination of existing resources from those programs within NSF that traditionally have supported research in materials, materials technology, and performance of constructed facilities and machines. NSF awards will be grants made to individual investigators and to small groups (three or more investigators). Award sizes are anticipated between \$200,000 and \$600,000 total for a period of up to three years, depending on the nature of the research activity. Subject to the availability of funds, the participating NSF programs have designated approximately \$5 million for this initiative. Additional support may be available from other agencies and programs. A total of about 15 awards are planned for this competition.

ELIGIBILITY

Proposals may be submitted by individual investigators or by small groups from universities. Synergistic collaboration among researchers and collaboration or partnerships with industry or government laboratories is encouraged when appropriate. Only one proposal may be submitted by a Principal Investigator and he/she may collaborate in one other proposal as a co-Investigator. Group and collaborative proposals involving more than one institution must be submitted as a single administration package from one of the institutions involved. Due to the limited availability of funds, prospective applicants are strongly urged to contact one of the program officers listed at the end of this document for guidance.

INSTRUCTIONS FOR PROPOSAL SUBMISSION

Proposals submitted in response to this Announcement must be prepared in accordance with the instructions provided in the NSF Grant Proposal Guide (GPG), NSF 98-2, and Proposal Forms Kit NSF 98-3. These guides are available in most university offices of sponsored research. Single copies of the GPG brochure and other NSF publications referenced in this announcement are available at no cost from: NSF Forms and Publications Unit, 4201 Wilson Boulevard - Room P 15, Arlington, VA 22230; telephone 703-306-1130; e-mail: pubs@nsf.gov. The NSF publications may also be accessed through "Search" on the NSF web page at: <http://www.nsf.gov>

Proposals must reference this program announcement (NSF 98-42) on the cover page. Page limitation guidelines will be strictly adhered to. No appendices to the proposal are permitted, and proposals submitted with appendices will be returned without review. Fifteen stapled copies of each proposal/proposal package, including one bearing original signatures from the institution(s) should be mailed to:

Announcement No. NSF 98-42
National Science Foundation
Room P60-PPU
4201 Wilson Boulevard
Arlington, VA 22230

An applicant who is submitting a proposal in response to this initiative using paper copies rather than electronic submission is required to prepare and submit the cover sheet using NSF FastLane. This will facilitate tracking the proposal. Instructions are enclosed (Appendix 1).

Proposals must be received at NSF no later than 5:00 PM EST on March 25, 1998. Proposals are encouraged to be submitted electronically via FastLane. For those submitted by FastLane, the signed cover page must arrive at NSF by April 1, 1998. For information, contact FastLane user support services (tel:703-306-1142; fastlane@nsf.gov).

PROPOSAL REVIEW

Proposals will be evaluated in accordance with the new NSF merit review criteria (see Appendix 2). Proposal review will be coordinated by a working group of NSF program

officers and representatives from the participating agencies. The selection process will involve a panel review to determine intrinsic merit and broad impact. Additional ad-hoc mail reviews may be used as well.

GRANT ADMINISTRATION

The final award recommendations will be a joint decision of the working group. Grants may be funded totally by an individual agency or jointly by multiple agencies. Grants will be administered by one of the relevant agencies as determined by the working group in accordance with the individual policies of the awarding agency.

NSF grants will be administered in accordance with the terms and conditions of NSF GC-1, "Grant General Conditions," or FDP-III, Federal Demonstration Partnership General Terms and Conditions," depending on the grantee organization. More comprehensive information on the administration of NSF grants is contained in the Grant Policy Manual (NSF 95-26).

INQUIRIES

Questions concerning this joint program should be addressed, preferably via e-mail, to the following NSF program officers:

Durability Modeling Working Group

Ken P. Chong, (kchong@nsf.gov 703-306-1361), Control, Mechanics and Materials Program

Jorn Larsen-Basse (jlarsenb@nsf.gov 703-306-1360), Control, Mechanics and Materials Program

Delcie Durham (ddurham@nsf.gov, 703-306-1330), Material Processing and Manufacturing

Other contacts

Division of Civil and Mechanical Systems (CMS) 703-306-1360

Clifford Astill, castill@nsf.gov; Hazard Reduction Program

Shih- Chi Liu, sliu@nsf.gov; Hazard Reduction Program

Priscilla Nelson, pnelson@nsf.gov; Construction, Geotechnical and Structures Program

John Scalzi, jscalzi@nsf.gov; Construction, Geotechnical and Structures Program

Devendra Garg, dgarg@nsf.gov; Control, Mechanics and Materials Program

Sunil Saigal, ssaigal@nsf.gov; Control, Mechanics and Materials Program

Division of Design, Manufacture, and Industrial Innovation (DMII) 703-306-1330

Ming Leu, mleu@nsf.gov, Manufacturing Machines & Equipment

GENERAL INFORMATION

The support of collaborations between university and industrial researchers can also utilize the mechanism of the GOALI Program (Grants Opportunities for Academic Liaison with Industry, NSF 97-116, <http://www.nsf.gov/goali>) and Small Business Innovative Research Program (SBIR, <http://www.nsf.gov/eng/dmii/sbir>).

APPENDIX 1: Instructions for Submission of Cover Sheets of Durability Proposals Using NSF FastLane.

If you are submitting your Durability proposal using paper copies rather than electronically, you are required to submit the proposal cover sheet to NSF using FastLane. To access FastLane, go to the NSF Web Site at <http://www.nsf.gov>, then select "FastLane" or go directly to FastLane (<http://www.fastlane.nsf.gov>).

Instructions for the Principal Investigator (PI):

Contact your Sponsored Research Office (SRO) for a PIN number to gain access to the FastLane "Proposal Preparation" application. If you have not submitted a proposal to NSF in the past, you must contact your SRO to be added to the NSF PI database. Please do this as soon as you decide to prepare the proposal for this announcement.

As early as possible, enter your cover sheet and budget information using the FastLane "Proposal Preparation" application. In the field labeled "Program Announcement," type in "NSF 98-42" exactly as shown, with no additional spaces or characters.

Click on the "Allow SRO Access" button. Allow time for your SRO to approve, copy and mail the proposal to meet the deadline. Contact your SRO to inform them of the proposal ID. If you save your forms as a "template," you can re-use the data on the forms in future proposals. (Once a proposal has been submitted, you can only view it.)

Print the cover sheet (and budget, if desired) and insert into the printed copy of the proposal.

Instructions for the Sponsored Research Office:

Print the second page of the cover sheet in time to obtain the required institutional signatures.

Before assembling the proposal for copying, submit the cover sheet to NSF via Fastlane using the "Submit Proposal" function within the "Institutional Management of FastLane" application. This will generate a proposal number. Allow at least one business day for this process.

Print a copy of the cover sheet; it will have the proposal number on it. Substitute the first page of the cover sheet for the one produced by the PI.

Make copies of the proposal and submit to NSF according to the usual procedures for a paper proposal. The hard copies of the proposal MUST be received at NSF by 5 p.m. Eastern time, March 25, 1998, in order to be eligible.

For EPSCoR-certified proposals, write EPSCoR only on the top right corner of the signed original.

APPENDIX 2: Merit Review Criteria

The National Science Board approved revised criteria for evaluating proposals submitted to NSF at its meeting on March 28, 1997 (NSB97-72). The revised criteria are designed to be useful and relevant across NSF's many different programs, however, NSF will continue to employ special criteria as required to highlight the specific objectives of certain programs and activities.

The revised merit review criteria are listed below. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Each reviewer will address only those that are relevant to the proposal and for which he/she is qualified to make judgments.

What is the intellectual merit and quality of the proposed activity?

How important is the proposed activity to advancing knowledge and understanding within its own field and across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

OTHER INFORMATION

The Foundation provides awards for research and education in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for the research findings or their interpretation.

The Foundation welcomes proposals from all qualified scientists and engineers and strongly encourages women, minorities, and persons with disabilities to compete fully in any of the research and education related programs described here. In accordance with federal statutes, regulations, and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from

participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF projects. See the program announcement or contact the program coordinator at (703) 306-1636.

Privacy Act. The information requested on proposal forms is solicited under the authority of the National Science Foundation Act of 1950, as amended. It will be used in connection with the selection of qualified proposals and may be disclosed to qualified reviewers and staff assistants as part of the review process; to applicant institutions/grantees; to provide or obtain data regarding the application review process, award decisions, or the administration of awards; to government contractors, experts, volunteers, and researchers as necessary to complete assigned work; and to other government agencies in order to coordinate programs. See Systems of Records, NSF 50, Principal Investigators/Proposal File and Associated Records, and NSF-51, 60 Federal Register 4449 (January 23, 1995). Reviewer/Proposal File and Associated Records, 59 Federal Register 8031 (February 17, 1994).

Public Burden. Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of your receiving an award.

The public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Gail A. McHenry, Reports Clearance Officer, Information Dissemination Branch, National Science Foundation, 4201 Wilson Boulevard, Suite 245, Arlington, VA 22230.

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the Foundation about NSF programs, employment, or general information. To access NSF TDD, dial (703) 306-0090; for FIRS, 1-800-877-8339.

This program is described in the Catalog of Federal Domestic Assistance category 47.041 (Engineering).

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ARLINGTON, VA 22230

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